

An Analysis of Selected Changes  
in the U.S. Grain Marketing System for 1990

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ABSTRACT

The impact of five different grain production or export scenarios on the national grain marketing system is evaluated using a linear programming model. A broad range of results suggest that optimal performance in the grain industry is induced by long-term public policy which maintains one scenario, rather than by inconsistent short-term policies.

## Introduction

In the 1970s, a dynamic U.S. grain-marketing system emerged in response to major changes in its components. Changes occurred in the amount of grain (corn, soybeans, and wheat) produced, quantity of grain traded in domestic and export markets, transportation technologies, and U.S. trade policy. Grain-handling capacity increased at production and export locations. Truck, rail, and barge services expanded to meet transportation needs, and grain flows to export markets increased relative to grain flows to domestic markets [Hill, Leath]. At the same time, international trade agreements and embargoes created an uncertain business environment for trading commodities.

These changes were unexpected, and caused agribusinessmen to misallocate resources. Misallocation resulted in shortages and surpluses of grain, grain-handling facilities, and transportation services. Surplus facilities created problems of asset fixity because facilities could not be used for other purposes. Shortages in facilities, on the other hand, prevented firms from acquiring enough new plants with which to meet high demand for grain.

Although exact changes which will influence investment decisions in the grain industry in the 1990s are unknown, it is likely that variations in grain production, domestic and export markets, and cost and availability of transportation services will be prominent factors. Since these factors are influenced in part by public policy decisions, the purpose of this paper is to present to policy makers the impact of a select set of changes on the U.S. grain-marketing system. It is important that policy makers be informed about alternative scenarios so that long-term, rather than short-term, policies affecting grain markets will be initiated. Long-term policies are desirable because they enable agribusinessmen to make optimum investments.

The selected changes to be analyzed are:

1. A base line model with moderate increases in grain production to 16.4 billion bushels in crop year 1989-90.
2. A model with rapid increases in grain production to 20.5 billion bushels in crop year 1989-90.
3. An increase in grain exports to 11.6 billion bushels by crop year 1989-90.
4. A decrease in grain exports to 3.5 billion bushels by crop year 1989-90.
5. Construction of super ports on the East and West Coasts and closing of Great Lakes ports.

#### Methodology

To analyze the impact of these changes on the U.S. grain marketing system, a linear programming model was constructed and solved at The Ohio State University for the crop year 1989-90. The model is a product of the Southern Regional Grain Marketing Research Project S-115 entitled, "Alternative Structures for Increasing Efficiency in Inter and Intra Regional Grain Marketing Systems."

The objective function of the linear programming model minimizes the total cost of assembling, storing, processing and transporting grain by six transportation options from 56 origins to 56 destinations and to eight export points for three commodities (corn, wheat and soybeans) in two time periods.<sup>1/</sup> The model contains one representative farm-storage firm per region, four different elevator types per region, three different feed manufacturers or feed mills per region, and one corn processor, wheat miller and soybean processor per region.<sup>2/3/</sup> Since the storage capacity per region and the supply of transportation services are not constrained, grain movements between time periods and across regions are limited by market regions' surpluses and disappearances.<sup>4/</sup> The criteria used to identify each marketing region within

a state or for a group of states were classes of grain produced, volume of grain produced, historic grain flow patterns, type of transportation, and number and type of elevators and processing firms.

Data from a 1970 survey [Stallings] and a 1977 North Central Southern Regional (NCSR) grain survey [Hill] were used to define the existing structure of the grain industry, grain flow patterns and routes among surplus and deficit grain producing regions. One central locale, a county or town, in each region was identified as a transportation point in order to calculate grain rail, truck and/or barge transport rates among the marketing regions and to export points [Free].

#### Base Line Model With Moderate Grain Production-Disappearance Levels

These U.S. production and disappearance data are derived by extrapolating the average annual percentage change in U.S. production and disappearance for the 1969-79 period to 1989-90 (Table 1). For this alternative, it is estimated that 9.5 billion bushels of corn, 3.8 billion bushels of soybeans, and 3.1 billion bushels of wheat will be produced in the U.S. in 1989-90. This represents an increase of 34 percent, 107 percent and 73 percent for corn, soybeans and wheat, respectively, from 1978 to 1989-90. Since some of the grain will be consumed in the region where it was produced, only 10.1 bushels will be traded in the national market, 6.7 billion bushels will be shipped to export, 900 million bushels will be shipped from surplus domestic regions to grain deficient regions, and 2.5 billion bushels will be stored. These data are allocated to the marketing regions and export ports based on historical percentage shares from the NCSR projections [Lazarus]. Results from the base line model are used as reference points for all selected changes analyzed in this paper. In addition, the estimated production data for the base line

Table 1: Corn, Soybean and Wheat Estimates for Baseline Production and High Production Alternatives for the U.S. and Eleven Production Regions, 1989-90

Regions	C O R N		S O Y B E A N S		W H E A T	
	High Grain <sup>1/</sup> Production	Baseline Moderate Grain <sup>2/</sup> Production	High Grain <sup>1/</sup> Production	Baseline Moderate Grain <sup>2/</sup> Production	High Grain <sup>1/</sup> Production	Baseline Moderate Grain <sup>2/</sup> Production
- - - - (000,000 Bu.) - - - -						
North East Region	285.0	210.0	13.0	11.1	25.1	24.6
Percent Change (1978 = 100)	169	124	150	129	211	207
Mid-Atlantic Region	475.5	350.5	177.5	152.6	41.5	40.6
Percent Change (1978 = 100)	190	140	263	226	249	244
South Atlantic Region	296.5	218.5	226.8	194.9	13.9	13.7
Percent Change (1978 = 100)	238	176	318	273	204	200
Mid-South Region	373.8	275.5	385.3	331.1	38.0	37.3
Percent Change (1978 = 100)	196	145	271	233	235	230
Delta Region	32.2	23.8	680.4	645.7	35.8	35.1
Percent Change (1978 = 100)	267	197	256	243	261	256
Corn Belt Region	6818.1	5025.3	2517.5	2049.0	311.6	305.5
Percent Change (1978 = 100)	177	130	249	203	221	216
Lake States Region	1830.4	3149.1	267.6	230.0	237.8	233.1
Percent Change (1978 = 100)	167	123	159	137	211	207
North Plains Region	2268.6	1672.1	190.5	163.7	1264.0	1239.3
Percent Change (1978 = 100)	209	154	223	192	171	168
South Plains Region	283.6	209.0	45.4	39.0	405.8	397.8
Percent Change (1978 = 100)	191	141	183	158	203	199
Pacific Region	99.1	73.0			323.1	316.8
Percent Change (1978 = 100)	223	164			139	137
Mountain Region	126.4	93.2			470.4	461.1
Percent Change (1978 = 100)	126	93			153	150
U.S. Total	12889.3	9500.0	4504.0	3817.1	3167.0	3105.0
Percentage Change	182	134	244	207	176	173

<sup>1/</sup> Percentage change in U.S. production between 1969 and 1979 extrapolated to 1989. U.S. production was allocated among states and regions based on percentage shares published by Lazarus.

<sup>2/</sup> Average annual percentage change in U.S. production for the 1969 to 1979 period extrapolated to 1989. U.S. production was allocated among states and regions based on percentage shares published by Lazarus.

model are used to analyze other selected changes, except for the High Production-Disappearance alternative.

#### High Grain Production-Disappearance Levels

For this alternative, the percentage change in U.S. grain production, domestic disappearance, and exports from 1969 to 1979 are extrapolated to 1989-90. Production is projected to be 12.9 billion bushels of corn, 4.5 billion bushels of soybeans and 3.2 billion bushels of wheat in crop year 1989-90 (Table 1). Total exports are constrained at the 1989-90 estimated level and carry over is endogenously determined vis-a-vis surplus grain minus grain disappearance.

It is estimated that 7.6 billion bushels of surplus corn, 2.6 billion bushels of surplus soybeans and 2.5 billion bushels of surplus wheat will enter the national market in crop year 1989-90. About 900 million bushels of grain will move from surplus marketing regions to deficit marketing regions, 10.3 billion bushels will move to export points and 1.5 billion bushels of grain will be stored.

#### Increased Grain Exports by 1989-90

The model for increased grain exports assumes that exports increase from the 6.7 billion bushels of the base line model to 11.6 billion bushels for crop year 1989-90. Of this total, 6.5 billion bushels are corn, 2.5 billion bushels are soybeans and 2.6 billion bushels are wheat. Since production is fixed at the level of the base line estimate, the increase in exports requires that domestic disappearance decrease by an equal amount. The increase in exports means that an estimated 6.9 billion bushels of corn, 3.6 billion bushels of soybeans and 2.7 billion bushels of wheat (13.1 billion bushels of grain) will be traded in 1989-90 in the national market, an increased of 42 percent relative to the base line estimate.

#### Decreased Grain Exports by 1989-90

In this alternative, grain exports are assumed to decrease from the 6.7 billion bushels of the base line model to 3.5 billion bushels for crop year 1989-90. Since disappearance of domestic grain is not changed from base line estimates, the volume of grain stored increases dramatically in this alternative. This alternative shows that 4.9 billion bushels of corn, 2.1 billion bushels of soybeans, and 2.6 billion bushels of wheat will be traded in 1989-90 in the U.S. market. For all grains, 900 million bushels will flow from surplus regions to grain deficient regions, 3.5 billion will flow to export points and 5.2 billion will be stored.

#### Construction of Super Ports by 1989-90

Since super ports may be widespread by 1989-90, very large ships would be able to transfer grain at lower cost from the U.S. to Europe, the Soviet block and/or to Asia. In this alternative, it is assumed that the super ports would be located on the Gulf Coast, the Atlantic and the Pacific coasts, and that Great Lakes ports would be closed. Further, it is assumed that all grain moving to the Gulf, Atlantic and Pacific coasts would move through super port locations.

#### Results

Marketing and transportation costs range from \$1.9 billion to \$3.5 billion for the five solutions (Table 2). A relatively high cost is generated for the high-grain-production alternative because large quantities of grain are transported from surplus grain areas to grain deficient regions and to export points. Marketing costs for the alternative of increased exports exceed costs generated by the 1989-90 base line alternative. This occurs because more grain flows to export points and because flow patterns



Table 2: U.S. Grain Marketing Costs and Shipments from Selected Regions to Deficit Regions and to Export Points for Five Selected Grain Marketing Alternatives, 1989-90<sup>1/</sup>

Grain/Activity	SELECTED GRAIN MARKETING ALTERNATIVES				
	High Grain Production	Baseline Moderate Grain Production	Increased Exports	Decreased Exports	Construction of Super Ports
TOTAL GRAINS					
Cost in 000,000 \$	3506.1	2614.2	3343.3	1936.7	3062.1
- - - BILLIONS OF BUSHELS - - -					
Shipments From Selected Regions to Domestic Regions					
Corn Belt	1.81	1.42	1.98	1.19	2.17
Lake States	0.08	0.05	0.03	0.07	0.24
North Plains	1.92	1.01	1.05	0.62	0.74
South Plains	0.22	0.21	0.27	0.16	0.21
Shipments From Selected Regions to Export Points					
Corn Belt	6.40	4.04	6.24	2.37	3.88
Lake States	1.94	1.22	2.04	0.64	0.91
North Plains	1.05	0.60	1.06	0.06	0.87
South Plains	0.92	0.56	0.87	0.28	0.88
Shipments by Mode of Transportation to Domestic Regions					
Truck	0.55	0.29	0.59	0.28	0.32
Barge	0.12	0.10	0.17	0.12	0.05
Rail	3.95	2.59	3.08	1.87	3.45
Total	4.63	2.98	3.85	2.26	3.82
Shipments by Mode of Transportation to Export Points					
Truck	0.85	0.67	1.00	0.30	0.90
Barge	4.38	2.72	5.11	2.11	2.24
Rail	5.21	3.46	5.56	1.23	4.09
Total	10.44	6.85	11.68	3.64	7.23

<sup>1/</sup> Grain equals corn, soybeans and wheat.

and transportation rates change to satisfy these added export demands. Marketing costs for the alternative of decreased grain exports are relatively low because the additional storage cost is less than the decrease in transportation cost. In the base line model, corn accounts for 56 percent, soybeans 16 percent, and wheat 28 percent of marketing and transportation costs. The soybean share of marketing and transportation costs changes little among the five alternatives because most soybeans tend to be processed in the region of production. The wheat share increases to 33 percent of total costs in the increased export alternative while the corn share decreases. It decreases because more wheat must be shipped over longer distances at higher cost. The corn share increases to 60 percent of total costs in the super port alternative because more corn is shipped by rail at higher cost to super ports on the East and West coasts.

#### Grain Shipments to Domestic Regions for Five Alternatives

Total shipments to all destinations including exports range from 9.8 billion bushels for the base line alternative to 15.1 billion bushels for the high production alternative (Table 2). For all five alternatives large quantities of grain are shipped from the Corn Belt and South Plains regions into the grain deficit domestic regions (Table 2). Corn shipments to the North East, Southeast and Southwest grain deficit regions originate in the Corn Belt. Wheat shipments to the Southeast, Southwest and North East originate in the Corn Belt, the Lake states and South Plains. Because most soybeans are exported or are processed in the regions in which they are produced, domestic soybean shipments are inconsequential relative to corn and wheat shipments. Over 80 percent of grain shipments are transported from grain surplus regions to deficit domestic regions by rail in all alternatives except for

the super port alternative, where rail transport accounted for 90 percent of shipments to deficit domestic regions (Table 2). Truck transportation is the next most important alternative and barge transportation is unimportant for shipments to deficit domestic regions.

Grain Shipments to Export Points for Five Alternatives

For all five alternatives most grain exports originate in the Corn Belt, with smaller amounts from the Lake states, North Plains and South Plains grain-production regions (Table 2). Corn and wheat originate primarily in the Corn Belt, the Lake states, the North Plains, and South Plains areas. Corn and wheat movements to the Lake and Atlantic Coast ports originate in the Corn Belt and Lake states. Corn and wheat shipments to the Gulf originate in the South, Corn Belt, and Lake states while shipments to the West Coast originate in the Plains and Lake states.

The Corn Belt ships soybeans to the Lake ports and in conjunction with the South exports grain via the Atlantic Coast port. Exports to the Gulf originate in the Corn Belt, South, Delta and Plains production areas, while exports to the West Coast originate in Minnesota and Iowa.

The above grain flow pattern changes when the super port policy is introduced, which closes down all but three ports. The Atlantic super port acquires corn from the Corn Belt and Lake states regions. The Gulf's exports originate in the Corn Belt and South while shipments to the West Coast originate in the Lake states, Plains, and Delta production areas. For wheat, the Atlantic super port acquires shipments from the Lake states, the Corn Belt, and the South; the Gulf's exports originate in the South, Delta, Corn Belt, Lake states, and Plains production area.

Over 90 percent of all export grain is shipped by either rail or barge for all five grain marketing alternatives (Table 2). The railroad share is slightly larger than the barge share in three of the five alternatives. The railroad share is double the barge share in the super port alternative because East and West coast super ports must receive grain for export by rail or truck. Although rail and barge shipments both decrease by large amounts in the alternative for decreased exports, the barge shipment decrease is less than that for railroads. The principal reason for this is that East and West coast exports decrease more than Gulf Coast exports.

As can be seen in Table 3, New Orleans is the most important export point in four of the five grain marketing alternatives. Baltimore, Norfolk, and Houston represent a second grouping in which each port handles about the same volume. The ports of Toledo, Chicago, Portland and Mobile represent a

Table 3: U.S. Grain Exports by Port for Five Selected Grain Marketing Alternatives, 1989-90

Grain Exports From	SELECTED GRAIN MARKETING ALTERNATIVES				
	High Grain Production	Baseline Moderate Grain Production	Increased Exports	Decreased Exports	Construction of Super Ports
- - - - Millions of Bushels - - - -					
Baltimore	1,500	1,000	1,800	500	0
Norfolk	1,200	700	1,200	400	2,700
New Orleans	4,100	2,200	3,900	1,200	2,000
Mobile	300	300	400	200	0
Houston	1,000	600	1,100	300	0
Toledo	700	500	900	200	0
Chicago	800	500	900	200	0
Portland	700	900	1,400	500	2,100
Total	10,300	6,700	11,600	3,500	6,800

third group in which each port is about the same size. The super port alternative concentrates all grain exports in the three locations of Norfolk, New Orleans and Portland. Because of the economics of size in ocean shipping, other ports are not competitive in the super port alternatives.

#### Conclusions and Implications

The results of this paper suggest that inconsistent changes in policy decrease the performance of the U.S. grain market. This occurs because some changes in policy render obsolete investments which have already been made by the private sector.

Policies which alter the volume of exports have a major impact on investment decisions for grain-handling and transportation facilities. Policies which increase exports induce investments in barge facilities relative to rail facilities and decrease investments in storage. During the 1970s, policies were enacted which both expanded and embargoed exports. The nature of private investments was directed by these contradictory policies, and the performance of the market was lowered as a result. If similar precedent prevails into the 1990s, the performance of the grain industry will continue to diminish.

Policies which initiate the building of super ports favor investments in rail facilities relative to barge facilities. Since this also influences the flow of grain from surplus-producing regions to both deficit regions and export points, traditional customer relationships could be disrupted by a super-port scenario. Further, the cost of handling and transporting grain from surplus regions to super ports is greater than the cost of shipping to traditional smaller ports. Thus, a study is required to determine whether or not

transportation rates to super ports can be reduced and/or whether or not the use of large ocean-going vessels is efficient.

Policies which increase grain surpluses require that the grain industry build storage space. The policy of the 1970s induced investment in storage space on farms. Should policy makers decide, in the future, to reduce grain surplusus, there would be an excess of on-farm storage.

Policies which vary grain production cause important changes in cost, amount, and direction of grain movements, in location of production, and in mode of transportation used. Grain movements from surplus regions to deficit regions in 1989-90 will follow many traditional grain-flow patterns. Rail will continue as the dominant mode for such movements. In like manner, rail and barge will continue as the dominant mode for transporting grain to export points. There is little evidence from this analysis (except for the super port alternative) to indicate that these patterns should change. Government policies toward user fees, rail-line mergers and deregulations, however, could change flow patterns and necessitate analyses of other alternatives.

#### Footnotes

<sup>1/</sup> See Baldwin for the mathematical specifications of the model.

<sup>2/</sup> Time period 1 includes wheat, corn, and soybean harvest (July to December) while time period 2 includes the winter feeding period (December to June).

<sup>3/</sup> The firm types were specified by representatives from the S-115 committee and from secondary sources. Definitions for the firms are listed in the following regional publications (Baldwin).

<sup>4/</sup> A region is defined as a surplus area if grain production within the region is greater than disappearance and a region is defined as a deficit area whenever the disappearance is greater than production.

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